

**Preliminary Estimates of Protected Species Bycatch Rates in the U.S. Atlantic Pelagic Longline Fishery Between 1 October and 31 December 2006**

Carol Fairfield-Walsh and Lance P. Garrison  
Southeast Fisheries Science Center  
75 Virginia Beach Dr.  
Miami, FL 33149  
E-mail: [Carol.Fairfield@noaa.gov](mailto:Carol.Fairfield@noaa.gov)

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**Background**

The U.S. Atlantic Pelagic Longline fleet operates throughout the Northwestern Atlantic Ocean including along the U.S. coast from the Gulf of Mexico to New England, the waters of the Caribbean, and in international waters of the central North Atlantic Ocean. The longline fishery has a documented history of incidental takes of non-target species including marine turtles and marine mammals. During recent years there have been elevated takes of leatherback turtles in the Gulf of Mexico (Garrison, 2003). As a result, a Biological Opinion on the pelagic longline fishery was developed by NOAA Fisheries under the Endangered Species Act, requiring several actions to be taken to improve monitoring and reduce interactions with leatherback and loggerhead turtles. These regulations reopened the Northeast Distant (NED) fishing area, with restrictions, on 30 June 2004, and similar restrictions were imposed on the rest of the fleet effective 5 August 2004. These regulations mandated that all pelagic longline gear use 16/0 or 18/0 circle hooks and eliminates J-hooks from the fishery.

The Biological Opinion requires quarterly reporting of interactions with protected species including marine mammals and marine turtles. The goal of this measure is to more closely monitor any potential short-term increases in interaction rates and thereby allow a more responsive management program. This report meets this requirement and includes the observed fishery effort and incidental takes reported by the pelagic longline observer program (POP) including sets from 1 October 2006 to 31 December 2006.

While it is desirable to directly estimate the absolute level of takes (i.e. the total number of turtles estimated to be taken by the fishery), fishery effort data is reported on logbook forms by fishing captains, and current data are therefore not available until several months after the end of any given quarter. As a result, we present the bycatch rate (i.e. catch per unit effort) based solely on observer data as an indicator of the relative level of interactions with protected species. The observed bycatch rate by fishing area during quarter 4 of 2006 is compared to that observed in quarter 4 of 2005 and to the average of the previous five years (2001-2005) for quarter 4, to assess whether or not the observed rate in 2006 is unusually high or low. Bycatch rates are calculated by applying the

delta log-normal method using hooks as the unit of effort. The analytical methods are described in detail in Garrison (2003).

## **Results and Discussion**

A total of 134 longline sets (~109,585 hooks) were observed during quarter 4 of 2006 (Table 1). The observed sets occurred primarily in the Gulf of Mexico (GOM), the Mid-Atlantic Bight (MAB), and the Northeast Distant (NED) fishing areas (Figure 1).

There were 14 observed interactions with leatherback turtles and 10 observed interactions with loggerhead turtles (Table 2). Three of the leatherbacks and one of the loggerhead turtles were released alive and uninjured, while 10 of the leatherbacks and 9 of the loggerheads were listed as released alive and injured, based on the observer's notes (Appendix A). In addition, one leatherback turtle was dead when fishing gear was retrieved. The locations of observed sets and turtle interactions are shown in Figure 1.

Ten interactions were observed with marine mammals during this quarter, all in the MAB area (Table 3, Figure 2). These included 6 interactions with pilot whales, two with unidentified dolphins, and one with an unidentified marine mammal. Two of the pilot whales were entangled but not hooked, and were considered to be released alive uninjured following removal of all gear. Four of the pilot whales and the two unidentified dolphins were judged to be seriously injured based upon observer comments and serious injury criteria (see Garrison, 2003; Angliss and Demaster, 1998). One of these dolphins swam away trailing gear, though the observer was not able to see any hook location. The other dolphin was entangled, sank motionless upon release, and thus may have been dead. One pilot whale was entangled, but the observer could not see if it was hooked, or if any gear was still attached upon release. The other three pilot whales were entangled upon release, and one of these may have been hooked in the mouth. One additional pilot whale and one unidentified marine mammal were entangled and were considered by the observer to be dead.

The quarterly and regional bycatch rates are summarized for marine turtles in Table 4 and for marine mammals in Table 5. These rates are compared with those from the same quarter/area for 2005 and the average for the fourth quarter/area from 2001-2005 in Tables 6 and 7 (Fairfield and Garrison, 2006; Garrison, 2005). Specific information on injuries to sea turtles and gear characteristics of each interaction are shown in Appendix A.

For leatherback turtles, the bycatch rate in the GOM was lower than that observed in 2005. The 95% confidence intervals for the rates from all three time periods overlap, however, and this difference may not be statistically significant (Table 6A). In the MAB and NEC areas, the 2006 fourth quarter bycatch rates were elevated relative to 2005, when no leatherback turtles were caught in either area. While the average rates for these areas in 2006 were lower than those for the 2001-2005 time periods, the confidence limits overlap suggesting no significant difference. The

leatherback bycatch rates for the NED area during the fourth quarter of 2006 were higher than those in previous years, though not significantly so (Table 6A).

The average bycatch rate for loggerhead turtles caught in the MAB during the fourth quarter of 2006 was higher than that in 2005 and lower than the 2001-2005 average, though the confidence limits for all three periods overlap (Table 6B) and thus are not significant. The NEC area loggerhead bycatch rate of zero was consistent with 2005, and lower than the 2001-2005 combined rate. The bycatch rate in the NED was elevated in comparison to previous years. Very little non-experimental fishing was observed in the NED area during the 2001-2005 time period, and only since summer 2004, so a direct comparison may not be valid. No loggerhead turtles were observed caught during the fourth quarter of 2004 in the NED area, and this area was not observed during this quarter in 2005.

During the period 2001 to 2005, there were two observed catches of unidentified turtles, one unidentified hard-shell turtle in November 2003 in the MAB and one unidentified turtle in December 2002 in the GOM areas (Table 6C).

Bycatch of pilot whales, unidentified dolphins, and an unidentified marine mammal were observed during the fourth quarter of 2006 in the MAB fishing area (Table 7). The bycatch rate for pilot whales in the MAB was elevated in comparison with previous years. The confidence limits for the three periods overlap, suggesting that these differences are not statistically significant. No takes of unidentified dolphins and unidentified marine mammals were observed during the fourth quarter in previous years in the MAB area. No common dolphins or Risso's dolphins were observed to be caught during the fourth quarter of 2006, though takes for these species had been previously observed in the MAB area for both species and the NEC area for Risso's dolphins between 2001 and 2005. The SAR fishing area was not observed during the fourth quarter of 2006, though takes had been observed for Atlantic spotted dolphins and unidentified dolphins in this area in previous years.

Only circle hooks (16/0 and 18/0) were observed during the fourth quarter of 2006, consistent with regulations for this fishery. Concerted efforts by fishers to remove hooks and disentangle captured turtles are also mandated by the Biological Opinion. Nine leatherbacks were hooked externally and all gear (hooks and line) were removed from five, while four were released with hooks and line attached (0.5 – 3.0 feet) (Appendix A1). Three additional leatherbacks were not hooked but rather were entangled, and were released without any gear attached. For one additional leatherback, the observer could not determine if it was hooked, and the turtle was released with trailing line attached. The dead leatherback was entangled in the line and the carcass was released still entangled.

The loggerheads captured during this fourth quarter of 2006 were hooked in the mouth (3 turtles), the external beak (2), or swallowed the hook (4), and one additional loggerhead was not hooked or entangled but had the bait in its mouth when observed (Appendix A2). The hook and trailing gear were retrieved from all six of the loggerhead turtles that had not swallowed the hook. Of the four

loggerheads that swallowed the hook, three were released with the hook and trailing line (0.1 feet) and one was released with the hook but no line.

There are a number of caveats and uncertainties associated with the current analysis. First, while these data have gone through an initial audit and review, they are subject to change upon further review after the end of the 2006 calendar year. Second, the delta log-normal estimator was applied to calculate bycatch rates consistent with previous estimates (e.g., Garrison 2003). This approach assumes 1) that catch rates (animals per hook) are lognormally distributed, and 2) that the number of hooks is an appropriate unit of effort. The first assumption has been evaluated for turtles; however, violations of this assumption may result in biased (positive or negative) estimates of catch rate and associated variances. The second assumption has not been examined critically in previous analyses. If this assumption is not correct, for example if there are saturation effects resulting in a non-linear relationship between the number of hooks and total catch, then there is potentially a bias in the estimate of bycatch rates.

The interaction between longline gear and protected species is a relatively rare event and is therefore inherently variable. Historically, there have been very large inter-annual fluctuations in bycatch rates and estimates of total bycatch. Thus, any differences observed between short term observations of bycatch rates and long term averages may be simply stochastic events and are not necessarily indicative of a significant change in the interactions between the longline fishery and protected species.

### **Literature Cited**

Angliss, R.P. and D.P. DeMaster. 1998. Differentiating Serious and Non-Serious Injury of Marine Mammals Taken Incidental to Commercial Fishing Operations: Report of the Serious Injury Workshop 1-2 April 1997, Silver Spring, Maryland. NOAA Technical Memorandum NMFS-OPR-13: 48 p.

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Garrison, L.P. 2003. Estimated Bycatch of Marine Mammals and Turtles in the U.S. Atlantic Pelagic Longline Fleet During 2001-2002. NOAA Technical Memorandum NOAA FISHERIES-SEFSC-515: 52 p.

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**Table 1.** Number of sets and hooks observed in the U.S. Atlantic Pelagic Longline Fishery between 1 October – 31 December 2006 by areas. Areas with missing values indicate there was no observer coverage during this time period in this area.

<b>Area</b>	<b># Sets</b>	<b># Hooks</b>
CAR	-	-
FEC	-	-
GOM	63	49,274
MAB	30	25,447
NCA	-	-
NEC	8	7,440
NED	33	27,424
SAB	-	-
SAR	-	-
TUN	-	-
TUS	-	-
<b>Total</b>	<b>134</b>	<b>109,585</b>

**Table 2.** Total observed interactions with marine turtles in the U.S. Atlantic Pelagic Longline Fishery for sets beginning from 1 October – 31 December 2006 by fishing area. One leatherback was reported dead in the Gulf of Mexico fishing area (\*). All other turtles were recorded as being released alive. Areas with missing values indicate no observer coverage during this time period.

<b>Area</b>	<b>Leatherback Takes Observed</b>	<b>Loggerhead Takes Observed</b>
CAR	-	-
FEC	-	-
GOM	3*	0
MAB	2	1
NCA	-	-
NEC	1	0
NED	8	9
SAB	-	-
SAR	-	-
TUN	-	-
TUS	-	-
<b>Total</b>	<b>14</b>	<b>10</b>

**Table 3.** Interactions with marine mammals observed during 1 October – 31 December 2006 in the U.S. Atlantic Pelagic Longline Fishery. Observer comments and criteria described in Angliss and DeMaster (1998) were used to evaluate serious injury.

<b>Species</b>	<b>Area</b>	<b># Released Uninjured</b>	<b># Serious Injury</b>	<b># Dead</b>
Pilot Whale	MAB	2	4	1
Unid. Dolphin	MAB	0	2	0
Unid. Marine Mammal	MAB	0	0	1

**Table 4.** Estimated bycatch rate (catch per 1000 hooks) for (A) Leatherback and (B) Loggerhead turtles by area during 1 October – 31 December 2006 in the U.S. Atlantic Pelagic Longline Fishery. Missing values indicate areas with no observer coverage. CV indicates the coefficient of variation of the estimated rate. One leatherback was reported dead in the Gulf of Mexico fishing area. All other turtles were recorded as being released alive.

A. Leatherback Turtles

Area	Type of Injury	Number of Turtles	Observed Sets	# Positive Sets	Mean CPUE	Var CPUE	CV
CAR	Alive	-	0	-	-	-	-
FEC	Alive	-	0	-	-	-	-
GOM	Alive	2	63	1	0.0353	0.0012	1
GOM	Dead	1	63	1	0.0276	0.0008	1
MAB	Alive	2	30	2	0.0739	0.0026	0.6952
NCA	Alive	-	0	-	-	-	-
NEC	Alive	1	8	1	0.1488	0.0221	1
NED	Alive	8	33	7	0.2856	0.0102	0.3537
SAB	Alive	-	0	-	-	-	-
SAR	Alive	-	0	-	-	-	-
TUN	Alive	-	0	-	-	-	-
TUS	Alive	-	0	-	-	-	-

**Table 4 (cont.)****B. Loggerhead Turtles**

<b>Area</b>	<b>Type of Injury</b>	<b>Number of Turtles</b>	<b>Observed Sets</b>	<b># Positive Sets</b>	<b>Mean CPUE</b>	<b>Var CPUE</b>	<b>CV</b>
CAR	Alive	-	0	-	-	-	-
FEC	Alive	-	0	-	-	-	-
GOM	Alive	0	63	0	0	-	-
MAB	Alive	1	30	1	0.0556	0.0031	1
NCA	Alive	-	0	-	-	-	-
NEC	Alive	0	8	0	0	-	-
NED	Alive	9	33	8	0.3239	0.0112	0.3261
SAB	Alive	-	0	-	-	-	-
SAR	Alive	-	0	-	-	-	-
TUN	Alive	-	0	-	-	-	-
TUS	Alive	-	0	-	-	-	-

**Table 5.** Estimated bycatch rate (catch per 1000 hooks) for marine mammals by area during 1 October – 31 December 2006 in the U.S. Atlantic Pelagic Longline Fishery. Under Type of Injury, Alive SI indicates animal released alive with a serious injury. CV indicates the coefficient of variation of the estimated rate.

Species	Type of Injury	Number of Animals	Area	# Positive Sets	# Observed Sets	Mean CPUE	Var CPUE	CV
Pilot Whale	Alive	2	MAB	2	30	0.0721	0.0025	0.6948
Pilot Whale	Alive SI	4	MAB	1	30	0.1873	0.0351	1
Pilot Whale	Dead	1	MAB	1	30	0.0381	0.0015	1
Unid. Dolphin	Alive SI	2	MAB	2	30	0.0650	0.0020	0.6949
Unid. Marine Mammal	Dead	1	MAB	1	30	0.0309	0.0010	1

**Table 6.** Bycatch rates for (A) Leatherback turtles and (B) Loggerhead turtles in the U.S. Atlantic longline fishery during 1 October- 31 December, 2006 and comparison to 2005 and the average rate from 2001-2005. 95% CI indicates the estimated 95% confidence interval of the mean bycatch rate (CPUE) in each cell assuming a lognormal distribution of rates. CPUEs reflect total turtles caught including alive and dead turtles.

A. Leatherback turtles

Area	2006 CPUE	2006 95% CI	2005 CPUE	2005 95% CI	2001-2005 CPUE	2001-2005 95% CI
CAR	-	-	-	-	-	-
FEC	-	-	0	-	-	-
GOM	0.0628	0.0187 – 0.2114	0.1544	0.0693 – 0.3442	0.1959	0.1360 – 0.2819
MAB	0.0739	0.0223 – 0.2447	0	-	0.1076	0.0628 – 0.1843
NCA	-	-	-	-	-	-
NEC	0.1488	0.0304 – 0.7274	0	-	0.2328	0.1237 – 0.4383
NED	0.2856	0.1485 – 0.5495	-	-	0.1036	0.0312 – 0.3440
SAB	-	-	-	-	0.2043	0.0418 – 0.9984
SAR	-	-	0.2385	0.1136 – 0.5005	0.2385	0.1136 – 0.5005
TUN	-	-	-	-	-	-
TUS	-	-	-	-	-	-

**Table 6 (cont.)****B. Loggerhead Turtles**

<b>Area</b>	<b>2006 CPUE</b>	<b>2006 95% CI</b>	<b>2005 CPUE</b>	<b>2005 95% CI</b>	<b>2001-2005 CPUE</b>	<b>2001-2005 95% CI</b>
CAR	-	-	-	-	0.2451	0.0501 – 1.1981
FEC	-	-	0	-	0.4008	0.1232 – 1.3042
GOM	0	-	0	-	0.0243	0.0094 – 0.0629
MAB	0.0556	0.0114 – 0.2716	0.0441	0.0090 – 0.2155	0.1057	0.0619 – 0.1805
NCA	-	-	-	-	-	-
NEC	0	-	0	-	0.0599	0.0181 – 0.1980
NED	0.3239	0.1767 – 0.5938	-	-	0	-
SAB	-	-	-	-	0.3128	0.1148 – 0.8524
SAR	-	-	0.1932	0.0701 – 0.5323	0.1932	0.0701 – 0.5323
TUN	-	-	-	-	-	-
TUS	-	-	-	-	-	-

**Table 6 (cont.)****C. Unidentified Turtles**

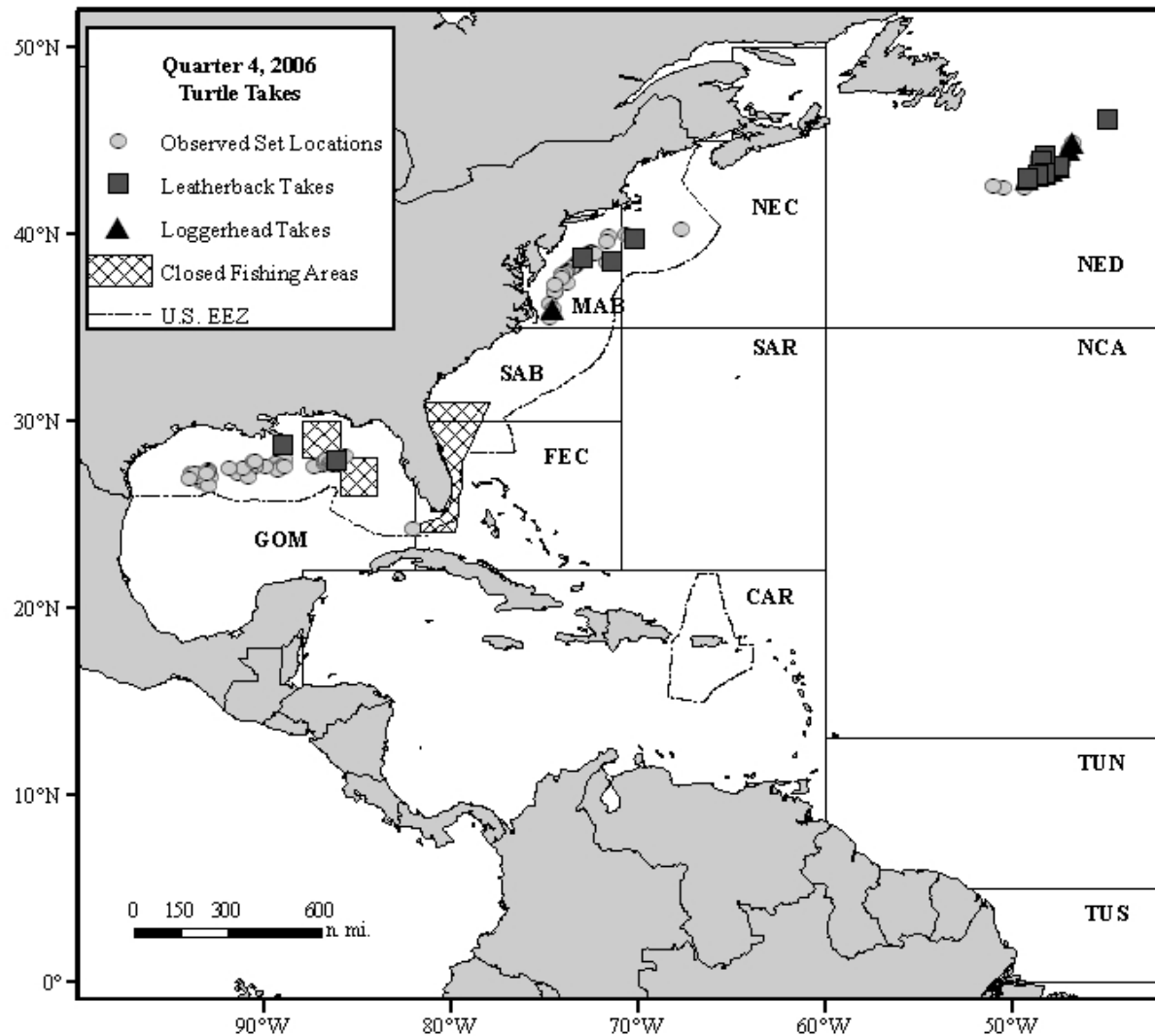
<b>Area</b>	<b>2006 CPUE</b>	<b>2006 95% CI</b>	<b>2005 CPUE</b>	<b>2005 95% CI</b>	<b>2001-2005 CPUE</b>	<b>2001-2005 95% CI</b>
CAR	-	-	-	-	-	-
FEC	-	-	0	-	-	-
GOM	0	-	0	-	0.0049	0.0010 – 0.0240
MAB	0	-	0	-	0.0073 <sup>1</sup>	0.0015 – 0.0359 <sup>1</sup>
NCA	-	-	-	-	-	-
NEC	0	-	0	-	-	-
NED	0	-	-	-	-	-
SAB	-	-	-	-	-	-
SAR	-	-	0	-	-	-
TUN	-	-	-	-	-	-
TUS	-	-	-	-	-	-

<sup>1</sup> Unidentified hard-shell turtle

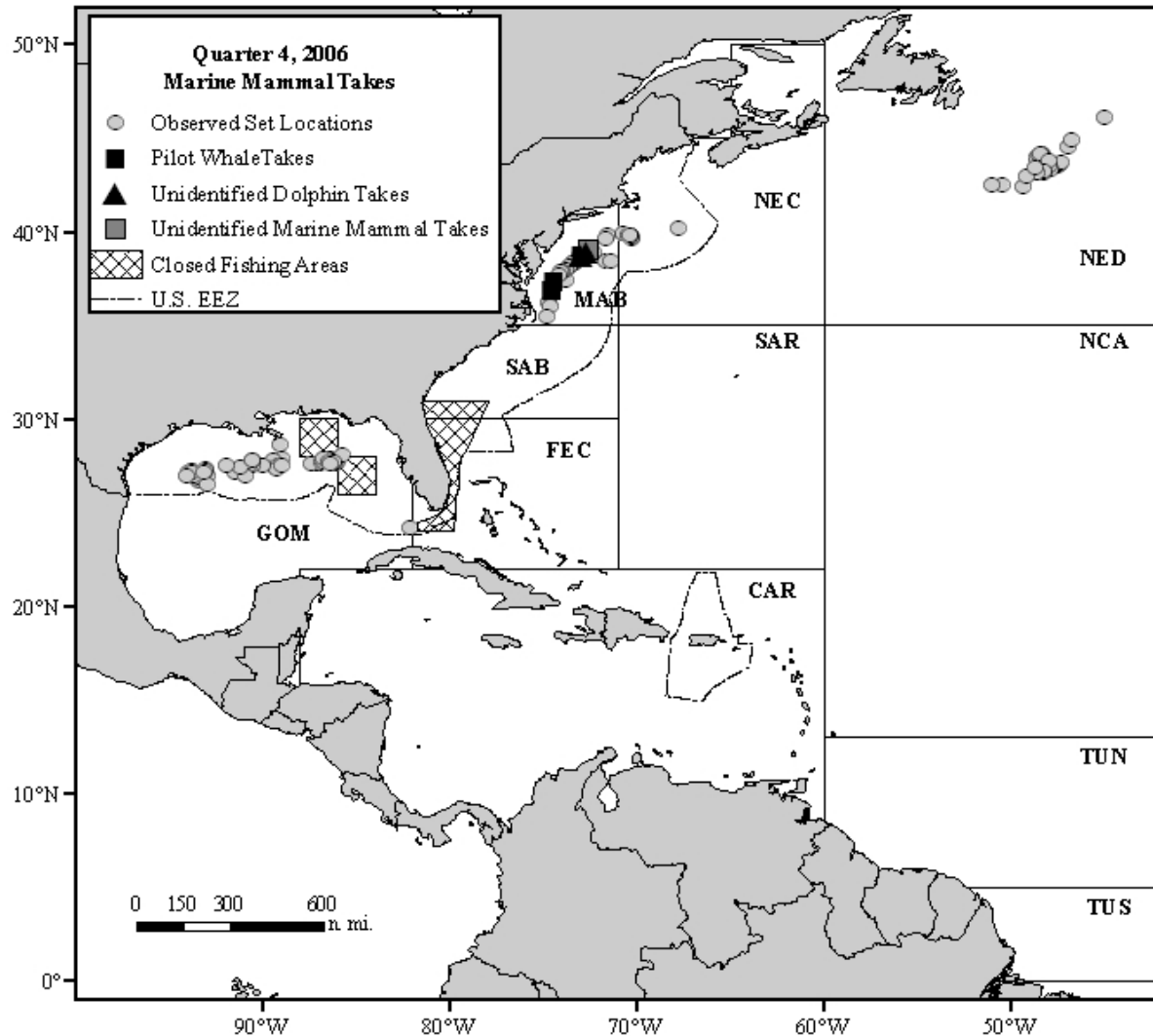
**Table 7.** Summary of bycatch rates for marine mammals in the U.S. Atlantic longline fishery during 1 October – 31 December, 2006 and comparison to rates from the previous year (2005) and the average of the previous five years (2001-2005). 95% CI indicates the estimated 95% confidence interval of the mean bycatch rate (CPUE) in each cell assuming a lognormal distribution of rates. CPUEs reflect total marine mammals caught including alive, dead, and seriously injured animals.

Species	Area	2006 CPUE	2006 95% CI	2005 CPUE	2005 95% CI	2001-2005 CPUE	2001-2005 95% CI
Atlantic Spotted Dolphin	SAR	0	-	0.0735	0.0150 – 0.3592	0.0735	0.0150 – 0.3592
Common Dolphin	MAB	0	-	0	-	0.0189	0.0039 – 0.0926
Pilot Whale	MAB	0.2799	0.0997 – 0.7859	0.0823	0.0168 – 0.4023	0.1435	0.0663 – 0.3102
Risso's Dolphin	MAB	0	-	0	-	0.0966	0.0533 – 0.1750
Risso's Dolphin	NEC	0	-	0.3490	0.0714 – 1.7062	0.2350	0.1257 – 0.4394
Unid. Dolphin	MAB	0.0650	0.0196 – 0.2150	-	-	0	-
Unid. Dolphin	SAR	-	-	0.0441	0.0090 – 0.2155	0.0441	0.0090 – 0.2155
Unid. Marine Mammal	MAB	0.0309	0.0063 – 0.1509	-	-	0	-

**Figure 1.** Observed U.S. Pelagic Longline Fishery effort and marine turtle interactions during 1 October – 31 December 2006. The pelagic longline fishing areas in the North Atlantic Ocean are as follows: CAR = Caribbean, GOM = Gulf of Mexico, FEC = Florida East Coast, SAB = South Atlantic Bight, SAR = Sargasso Sea, MAB = Mid-Atlantic Bight, NEC = Northeast Coastal, NED = Northeast Distant, NCA = North Central Atlantic, TUN = Tuna North and TUS = Tuna South. Closed fishing areas and the U.S. Exclusive Economic Zone (EEZ) are shown.



**Figure 2.** Observed U.S. Pelagic Longline Fishery effort and marine mammal interactions during 1 October – 31 December 2006. The pelagic longline fishing areas in the North Atlantic Ocean are as follows: CAR = Caribbean, GOM = Gulf of Mexico, FEC = Florida East Coast, SAB = South Atlantic Bight, SAR = Sargasso Sea, MAB = Mid-Atlantic Bight, NEC = Northeast Coastal, NED = Northeast Distant, NCA = North Central Atlantic, TUN = Tuna North, and TUS = Tuna South. Closed fishing areas and the U.S. Exclusive Economic Zone (EEZ) are shown.



**Appendix A:** Injury details and hook types for turtles captured in the U.S. Atlantic Pelagic Longline Fishery for sets during 1 October – 31 December 2006.

**1. Leatherback Turtles**

#	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Release Condition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	GOM	C-16/0	0	squid	225	Alive, injured	rear flipper	No	No	No	1.00	7.00		
2	GOM	C-16/0	0	squid	225	Alive, injured	unknown location	No	No	No	8.00			
3	GOM	C-16/0	0	sardine	90	Discarded unmarked carcass	not known if hooked	No	Yes	Yes	100.00	4.50		
4	MAB	C-18/0	10	squid or mackerel	161 or 332	Alive, injured	armpit	Yes	No	No	0.00	4.50		
5	MAB	C-18/0	10	squid or mackerel	170 or 341	Alive, injured	shoulder	No	No	No	3.00	4.50		
6	NEC	C-18/0	10	mackerel	135	Alive, uninjured	not hooked	na	Yes	No	0.00	5.00		
7	NED	C-18/0	10	squid or mackerel	144 or 363	Alive, injured	armpit	Yes	Yes	No	0.00	5.50		
8	NED	C-18/0	10	squid or mackerel	218 or 343	Alive, injured	armpit	No	No	No	0.50	4.50		
9	NED	C-18/0	10	mackerel	402	Alive, injured	plastron	Yes	No	No	0.00	5.00		
10	NED	C-18/0	10	squid or mackerel	218 or 375	Alive, injured	shoulder	Yes	No	No	0.00	4.00		
11	NED	C-18/0	10	squid or mackerel	218 or 343	Alive, injured	shoulder	No	No	No	1.50	4.50		
12	NED	C-18/0	10	squid	189	Alive, injured	shoulder	Yes	No	No	0.00	3.50		
13	NED	C-18/0	10	mackerel	426	Alive, uninjured	not hooked	na	Yes	No	0.00	5.00		

14	NED	C-18/0	10	squid or mackerel	146 or 363	Alive, uninjured	not hooked	na	Yes	No	0.00	5.00		
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## 2. Loggerhead Turtles

#	Area	Hook Type	Offset (degrees)	Bait	Bait Size (g)	Release Condition	Hook Location	Hook Removed?	Entangled Capture?	Entangled Release?	Line Left (ft)	CL Est. (ft)	CCL (cm)	Straight N-N (cm)
1	MAB	C-18/0	10	squid	113	Alive, injured	mouth, lower, other	Yes	No	No	0.00			
2	NED	C-18/0	10	squid or mackerel	218 or 375	Alive, injured	beak external, lower jaw	Yes	No	No	0.00		65	57.7
3	NED	C-18/0	10	squid	214	Alive, injured	beak external, upper jaw	Yes	No	No	0.00		70	62
4	NED	C-18/0	10	squid	144	Alive, injured	mouth, lower jaw, other	Yes	No	No	0.00		57.2	53
5	NED	C-18/0	10	mackerel	372	Alive, injured	mouth, upper jaw, other	Yes	No	No	0.00		54	48.3
6	NED	C-18/0	10	squid or mackerel	214 or 308	Alive, injured	swallowed, hook not visible	No	No	No	0.10		54.4	49.4
7	NED	C-18/0	10	squid or mackerel	218 or 343	Alive, injured	swallowed, hook not visible	No	No	No	0.10		61.2	55.5
8	NED	C-18/0	10	squid or mackerel	189 or 345	Alive, injured	swallowed, hook not visible	No	No	No	0.10		65	59.3
9	NED	C-18/0	10	mackerel	513	Alive, injured	swallowed, partial hook visible	No	No	No	0.00		63	57.1
10	NED	C-18/0	10	squid	145	Alive, uninjured	not hooked	na	No	No	0.00	2.20		

